REPORT ON

PRODUCTION OF ANHYDROUS ETHANOL USING CORN MEAL ABSORBER

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INTRODUCTION

The alcohol plant at Tuskegee University is capable of producing 180 proof alcohol at a rate of 5 gallons/hr. Efforts are underway to equip this plant with a dehydration unit cabable of producing 199 proof alcohol. As a part of this effort technology developed at Purdue University by Dr. Mike Ladisch was reviewed and is being adopted. The overall objectives of this work include (i) a background study of literature and laboratory work performed at purdue, (ii) design, fabricate and test a laboratory scale dehydration unit and (iii) upon successful completion to build a scale up unit. The schematic and design details of the laboratory scale unit were described in the previous report. In the subsequent period, fabrication and testing of heat exchangers has been mostly completed. During the test, the heat exchangers performance was found quite adequate.

FACILITY

A schematic of the laboratory dehydration unit is shown in Figure 1. This facility consists of a 4 inch dia and 32 inch high steel column packed with corn grits. The steel column is connected to two heat exchangers on both ends. The feed (180 proof ethanol-water mixture) is pumped using a metering pump at a steady flow rate. The feed is heated from room temperature to 100°C in one of the heat exchangers (H_1) before it enters the packed column. The anhydrous ethanol vapors collected at the top

of the column are condensed in the condenser (C_1). The temperature in the column is monitored at no less than six locations using thermocouples. A down flow regeneration is carried out using heated nitrogen after each run. Heat exchanger H_2 and consenser C_2 are primarily used to heat and cool the regenerating gas to the desired temperature.

FABRICATION AND START UP

The fabrication and testing of heat exchangers H_1 and H_2 are now completed. A schematic of these exchangers is shown in Figure 2. Each exchanger has one steel shell made of steel tube with flanges welded on both ends. A half inch stainless steel U-tube serves as the carrier of ethanol feed. The steam is supplied from the boiler and the exit steam is let to the cooker. The heat exchangers are covered with Microlock insulation (thermal conductivity of 0.3 Btu/hr/ft). During the test when the feed rate was 20 lb/hr, the inlet and outlet temperatures of the feed were 60 and 200°C respectively. Similarly air at an inlet temperature of 60°C will be supplied to the heat exchanger and the maximum attainable temperature at desired flow rates will be examined in the subsequent tests.

PLANT VISIT

Before testing this heat exchanger, a visit was made to the Muscle Shoals unit of TVA to examine the cornmeal adsorber

facility which is already in place and functional. In addition, a future visit is also planned to examine the facility at Purdue University.

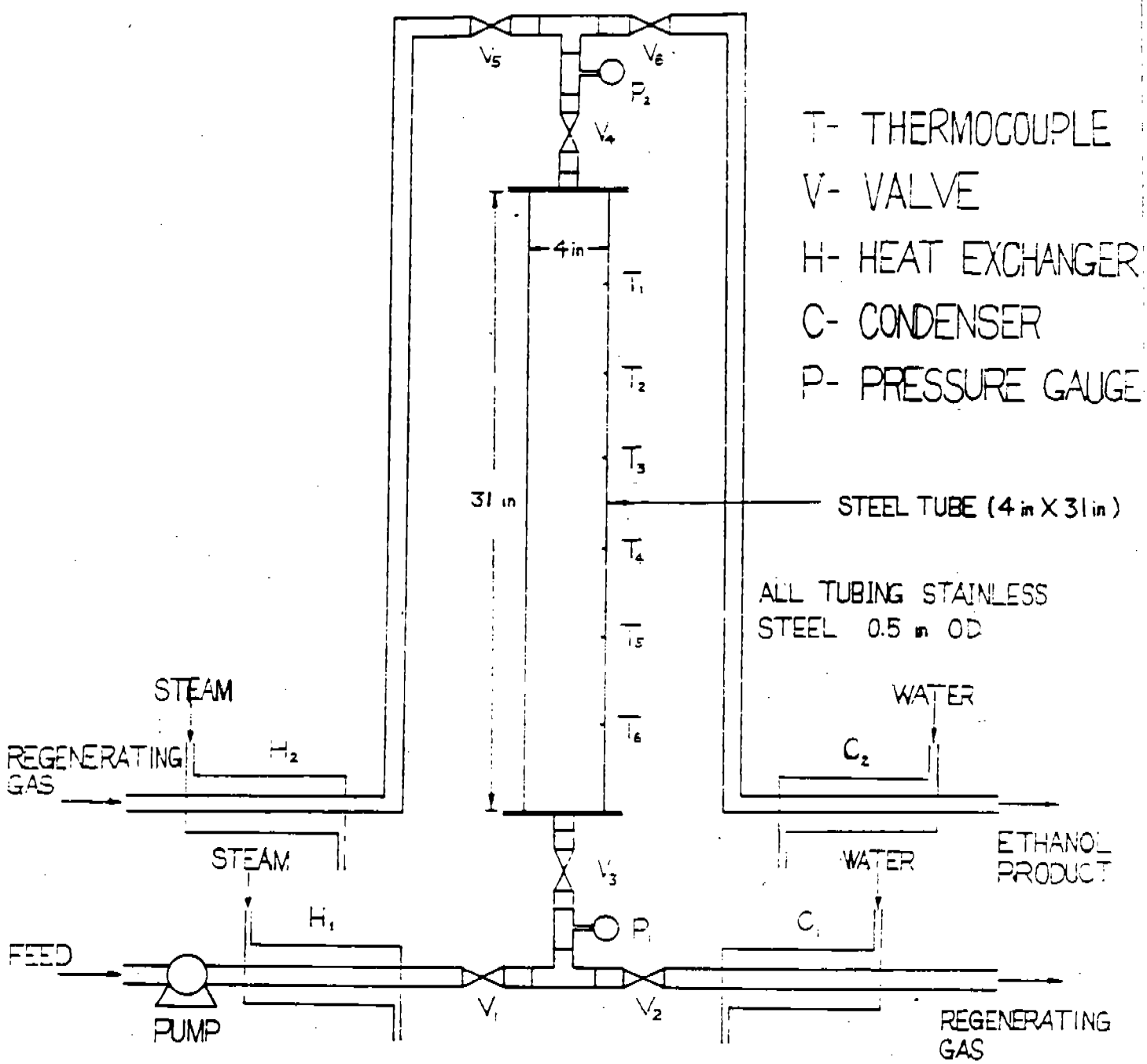

FIGURE 1 PILOT SCALE ADSORBER

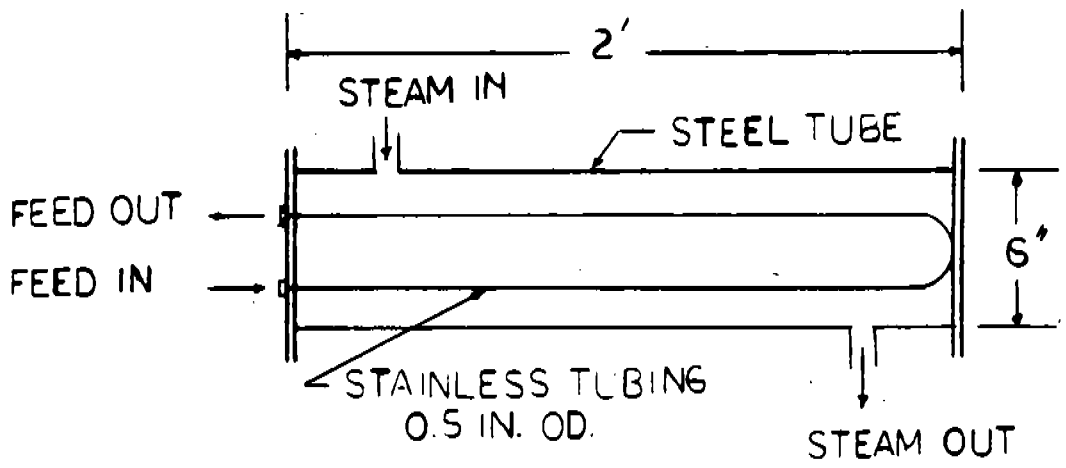

FIGURE 2 HEAT EXCHANGER

REFERENCES

1. M. R. Ladisch, M. Voloch, J. Hong, P. R. Bienkowski, and G. T. Tsao, I&EC Process Design & Development, 23, 437 (1984).

2. M. R. Ladisch and G. T. Tsao, U. S. Patent 4, 345,973, August 24 (1982).

3. M. R. Ladisch and K. K. Dyck, Schience, 205, 898 (1979).

4. M. Voloch, J. Hong, and M. R. Ladisch, "Dehydration of Ethanol Using Cornmeal as an Adsorbent," presented at the 180th National Meeting of the American Chemical Society, Las Vegas, NV, 1980.

5. J. Hong, M. Voloch, M. R. Ladisch, and G. T. Tsao, Biotechnol Bioeng., 24, 725 (1982).

6. C. Y. Pan and D. Basmadjian, Chem. Eng. Sci., 25, 1653 (1970).